

October 1997

Preliminary Data Summary

by Field Research Facility

U.S. Army Corps of Engineers
Waterways Experiment Station
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Preface

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Measurements and Analysis work units at the U.S. Army Corps of Engineers Waterways Experiment Station, Coastal and Hydraulics Laboratory (CHL), Field Research Facility (FRF) in Duck, North Carolina. The FRF staff collected and analyzed these data. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

Data from these reports are now available via the World Wide Web at
<http://www.frf.usace.army.mil>

These web pages contain general information about the Field Research Facility and data from 1980 to the present.

Your comments and suggestions are welcome.

Introduction

1

The U.S. Army Corps of Engineers Waterways Experiment Station, Coastal and Hydraulics Laboratory (CHL), Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The research pier is a reinforced concrete structure supported on 0.9-m-diam steel piles spaced 12.2 m apart along the pier's length and 4.6 m apart across the width. The pier deck is 6.1 m wide and extends from behind the duneline to about the 6-m water depth contour at a height of 7.75 m above the National Geodetic Vertical Datum (NGVD) of the year 1929.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local bathymetric, oceanographic, and meteorological conditions. This summary is intended to provide basic data as soon as possible after they are obtained. Questions and/or comments concerning the data may be directed to Mr. Clifford F. Baron at (252)261-6840 ext.222 (c.baron@cerc.wes.army.mil).

Chapter 2 presents the meteorological data; Chapters 3 through 6 present oceanographic data; Chapter 7 presents nearshore profiles and bathymetry; and Chapter 8, if included, documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used and their operational status during the month. Figure 2 shows weather and ocean conditions for the month. Table 2 and Figure 3 identifies the location of the instruments. The water depths at the wave gauges and current meters vary and may be determined from information contained in Figure 9. Other installation information is contained in Table 2.

Times given in the report are referenced to eastern standard time (EST).

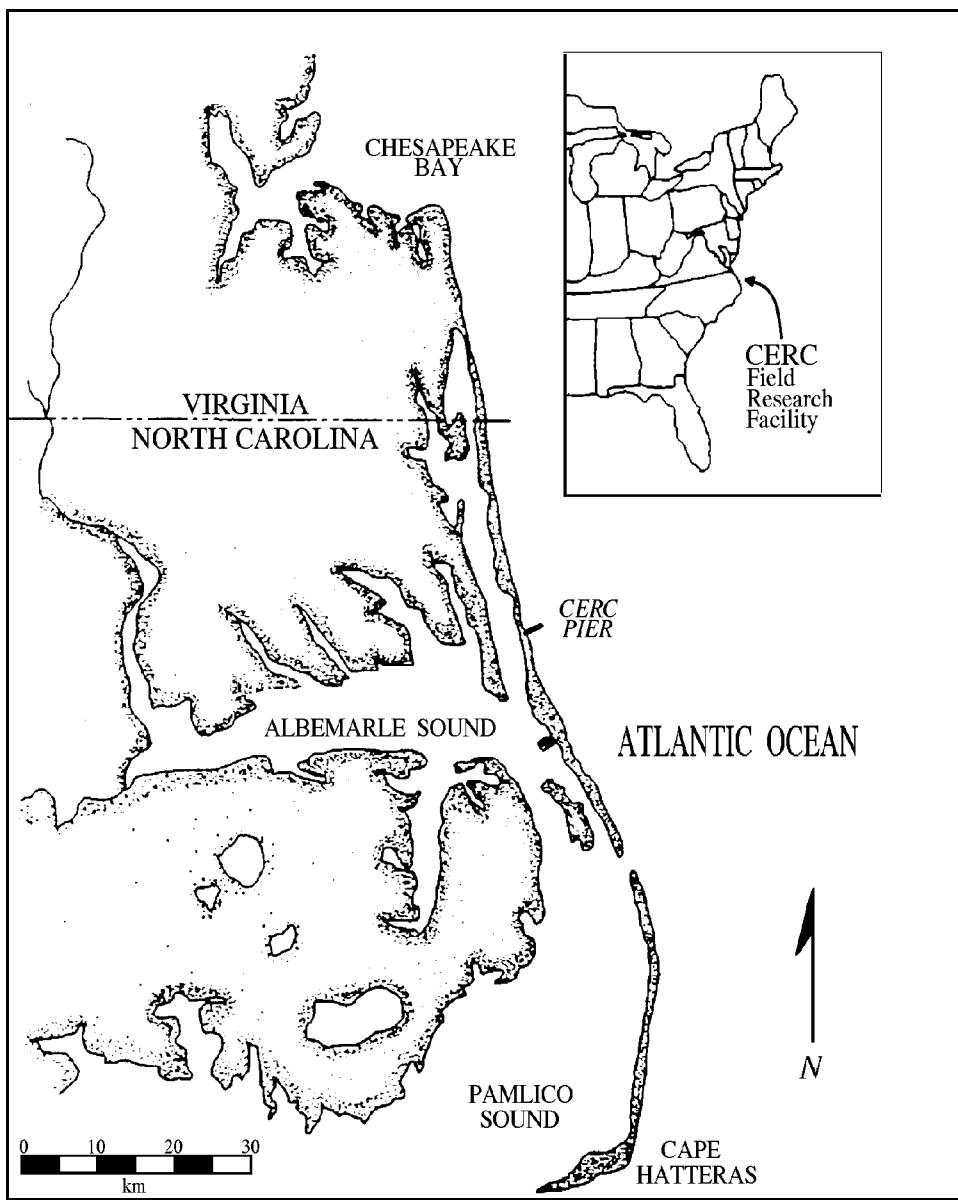


Figure 1. FRF Location Map

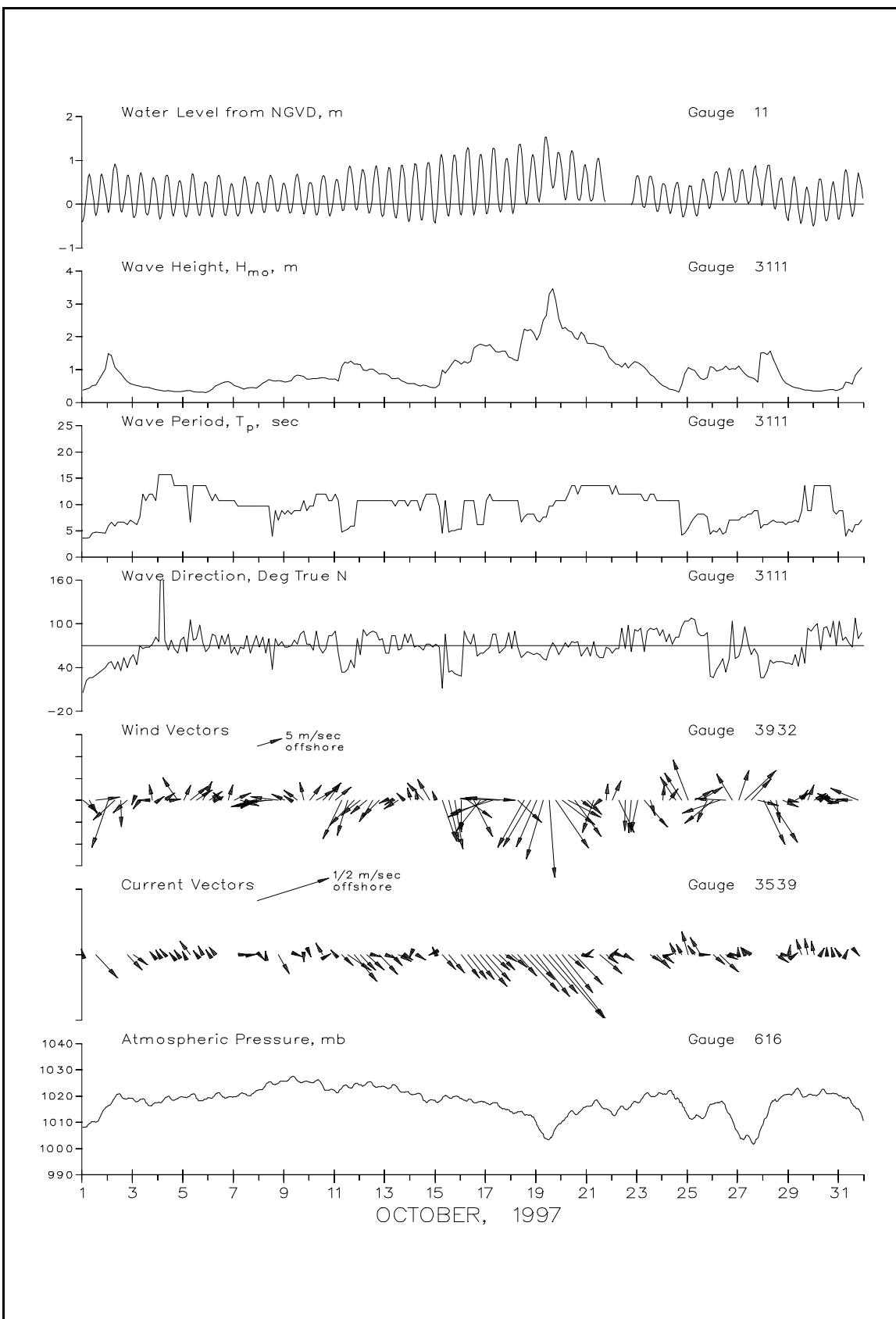


Figure 2. Month at a Glance

Table 1
Instrument Status/Data Availability

		October 1997																																
		Day of the month																																
Gauge ID	Description/Remarks	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1		
616	Atmospheric Pressure	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
604	Precipitation	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
624	Air Temperature	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
3932	Anemometer	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
641	Pressure Gauge on FRF pier	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
625	Baylor staff on FRF pier	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
3111	8 Meter Array 309 m north of FRF	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
111	Pressure Gauge center of 8 Meter Array	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
630	Waverider buoy 4.0 km offshore	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
3539	Current meter 343 m north of FRF pier (1.6 km offshore)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	/	/	*	/	/	/	/	*	*	/	*	*	*	/	*	*	*	/	/	*	*	/	*	*	/	*	/	*	*			
11	NOAA tide gauge at end of pier	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
Visual Observations (daily oceanographic and meteorological observations)		Daily observation	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
Gauge Status		*	= Operational	/	= Partial	-	= Non-Operational																											
Data Collected		*	= All	/	= Partial	-	= None																											
Visual Observations		*	= Complete	/	= Partial	-	= None																											

Table 2
Gauge Locations

Gauge*	Description	* Latitude	* Longitude	* FRF Coordinates	* Gauge Depth	* Water Depth
ID *		Degrees N	Degrees W	Crossshore	Longshore*	NGVD, m
616	* Atmospheric Pressure*	36 10' 57.03"	*	75 45' 5.50"	11.60 *	569.00 *
		*	*	*	*	*
3932	* Anemometer	36 11' 1.23"	*	75 44' 43.07"	585.20 *	517.30 *
		*	*	*	*	*
641	* Pressure Gauge	36 10' 57.71"	*	75 44' 56.23"	239.11 *	516.64 *
		*	*	*	*	*
625	* Baylor Staff	36 11' 1.04"	*	75 44' 43.72"	568.00 *	516.64 *
		*	*	*	*	*
3111	* 8 Meter Array North	36 11' 19.14"	*	75 44' 36.41"	915.23 *	990.16 *
		*	*	*	*	*
	* 8 Meter Array South	36 11' 11.28"	*	75 44' 33.28"	914.20 *	735.37 *
		*	*	*	*	*
	* 8 Meter Array East	36 11' 13.70"	*	75 44' 32.56"	954.51 *	800.58 *
		*	*	*	*	*
	* 8 Meter Array West	36 11' 12.48"	*	75 44' 37.11"	834.66 *	800.37 *
		*	*	*	*	*
111	* Pressure Gauge in center of 8 M Array	36 11' 14.06"	*	75 44' 34.39"	914.43 *	825.52 *
		*	*	*	*	*
630	* Waverider Buoy	36 10' 5.10"	*	75 41' 59.30"	3934.96 * -2400.81	Surface *
		*	*	*	*	*
3539	* Current Meter	36 11' 23.57"	*	75 44' 9.12"	1605.80 *	907.60 *
		*	*	*	*	*
11	* NOAA Tide Gauge	36 11' 1.25"	*	75 44' 42.60"	596.49 *	514.20 *
		*	*	*	*	*
R	R	R	R	R	R	R

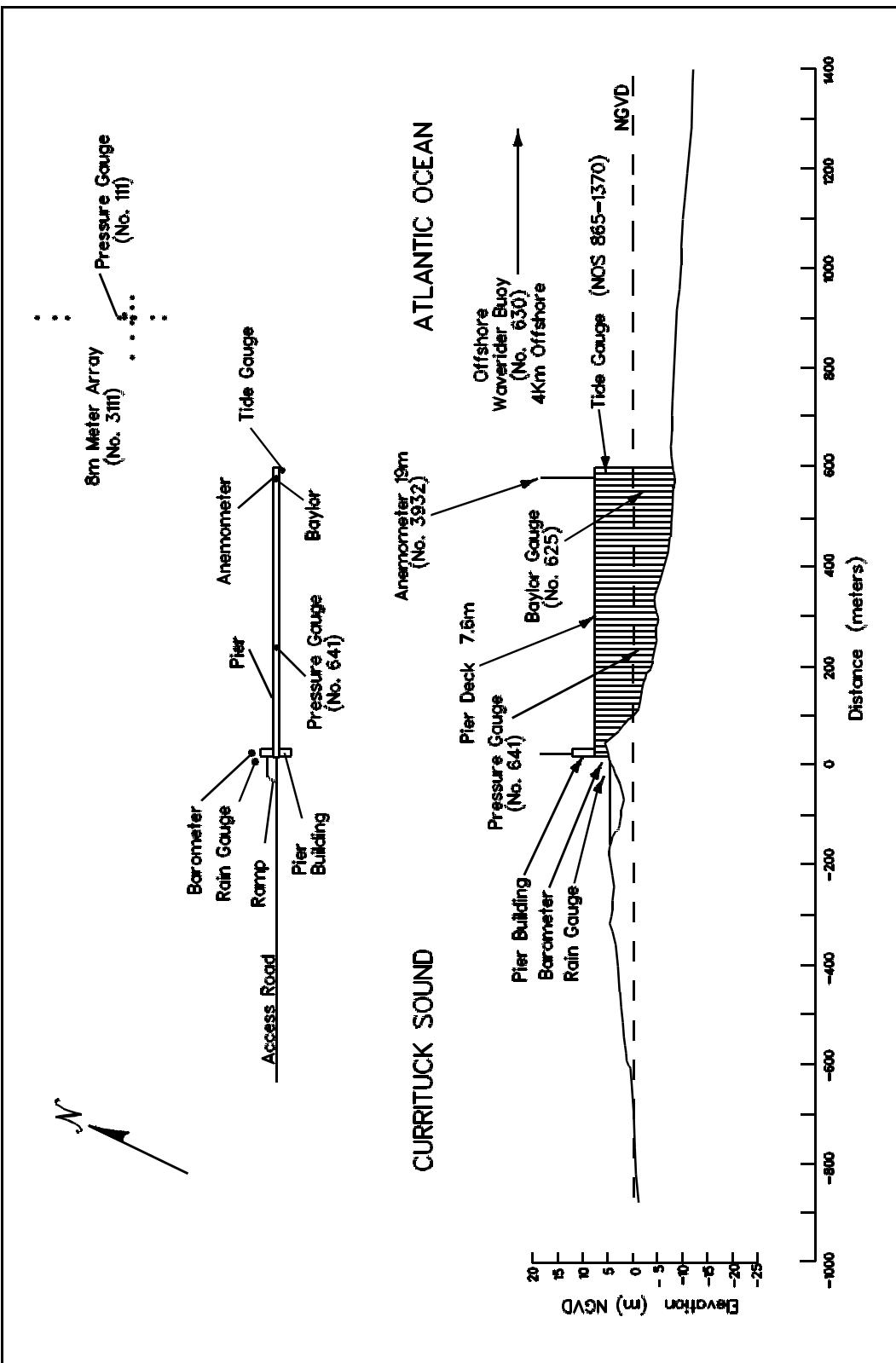


Figure 3. Instrument Locations, Elevations From NGVD

Meteorological Data

2

A variety of instruments have been installed at the FRF (Figure 3) to monitor the meteorological conditions. The data presented in Table 3 are collected and stored using a Digital Equipment Corporation VAXstation 4000. For each instrument identified in Table 1, a log is maintained and the records are stored for future reference.

Winds were measured at the end of the pier at an elevation of 19 m using a WeatherMeasure Skyvane anemometer. Monthly resultant wind speeds and directions (Figure 4) are determined by vector averaging the data. Wind directions (Table 3) indicate where the wind is coming from. Temperature and atmospheric pressure means (Table 3) are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 3 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in.) -
 $mm \times .03937 = in.$
2. Millibars (mb) to inches of mercury (in. Hg) -
 $mb \times 0.02953 = in. Hg$
3. Degrees Celsius (C) to degrees Fahrenheit (F) -
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -
 $m/s \times 1.943 = kn$

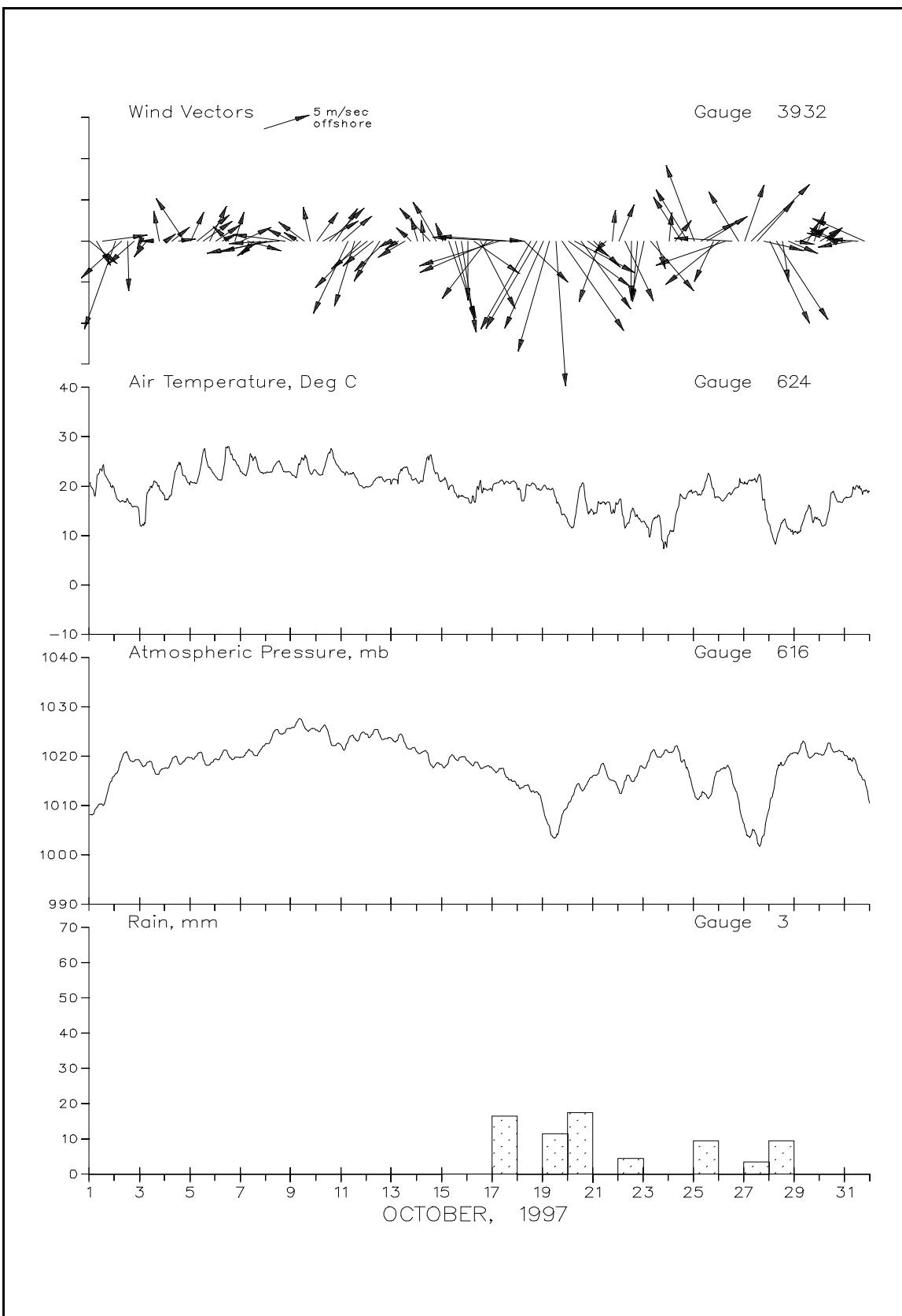


Figure 4. Meteorological Monthly Summary

Table 3
Meteorological Data

Oct 1997						
Precipitation	Wind		Temperature		Atm	
	Day	Hour	Speed m/sec	Direction deg TN	deg C	Pressure mb
1	100	4	314	20.7	1008.2	0
	700	3	333	20.4	1009.5	0
	1300	5	261	24.0	1010.2	0
	1900	7	357	20.7	1014.3	0
2	100	11	16	18.4	1016.5	0
	700	6	43	17.0	1019.4	0
	1300	6	359	17.3	1020.3	0
	1900	4	44	15.9	1019.0	0
3	100	1	20	12.0	1018.8	0
	700	2	34	18.2	1018.7	0
	1300	1	87	20.4	1017.5	0
	1900	4	170	19.5	1016.7	0
4	100	1	230	17.3	1017.7	0
	700	2	228	19.3	1019.2	0
	1300	2	262	24.3	1018.8	0
	1900	6	150	22.1	1019.0	0
5	100	4	201	21.0	1019.7	0
	700	5	227	20.9	1020.2	0
	1300	4	231	27.0	1019.3	0
	1900	5	202	23.9	1018.4	0
6	100	3	232	21.9	1019.5	0
	700	2	241	21.9	1020.7	0
	1300	2	137	28.0	1020.1	0
	1900	4	194	25.3	1019.8	0
7	100	4	242	22.9	1019.8	0
	700	4	288	23.1	1021.0	0
	1300	2	36	25.5	1020.4	0
	1900	3	52	22.9	1021.1	0
8	100	5	74	22.8	1022.6	0
	700	7	77	23.2	1024.3	0
	1300	5	86	25.2	1024.8	0
	1900	6	97	22.9	1024.9	0
9	100	3	119	22.4	1025.8	0
	700	2	126	23.2	1027.2	0
	1300	4	130	25.4	1026.0	0
	1900	4	169	22.6	1025.5	0
10	100	4	212	22.8	1025.4	0
	700	4	237	22.8	1026.0	0
	1300	5	222	26.9	1023.9	0
	1900	5	210	24.8	1022.3	0

Table 3
Meteorological Data (continued)

Oct 1997						
Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
11	100	4	225	22.9	1022.0	0
	700	10	22	22.5	1023.1	0
	1300	8	14	22.2	1023.6	0
	1900	7	39	20.1	1024.6	0
12	100	5	47	19.9	1024.5	0
	700	4	46	20.9	1025.0	0
	1300	6	29	21.7	1024.4	0
	1900	5	41	21.1	1023.6	0
13	100	1	61	21.3	1023.5	0
	700	2	53	22.2	1024.0	0
	1300	3	54	23.8	1022.7	0
	1900	2	136	22.3	1021.5	0
14	100	3	166	20.9	1020.9	0
	700	2	173	22.2	1021.0	0
	1300	5	141	26.3	1018.6	0
	1900	5	152	22.7	1018.5	0
15	100	2	160	21.3	1018.0	0
	700	10	343	19.2	1019.2	0
	1300	10	348	18.6	1019.5	0
	1900	11	352	18.1	1020.0	0
16	100	7	359	17.6	1019.0	0
	700	6	309	17.0	1018.4	0
	1300	9	336	21.2	1017.6	0
	1900	8	33	19.3	1018.0	0
17	100	9	63	20.1	1017.3	0
	700	9	70	20.8	1017.5	16
	1300	8	93	20.8	1016.2	0
	1900	8	94	20.9	1015.0	0
18	100	1	274	19.3	1014.2	0
	700	7	317	17.5	1014.0	0
	1300	12	26	20.2	1012.9	0
	1900	12	26	19.5	1012.8	0
19	100	11	20	20.0	1009.2	0
	700	14	13	19.4	1005.8	11
	1300	18	356	17.6	1003.6	0
	1900	13	329	14.1	1008.1	0
20	100	8	310	12.5	1010.5	0
	700	7	301	13.2	1013.1	17
	1300	10	327	20.0	1013.4	0
	1900	3	310	14.8	1014.7	0

Table 3
Meteorological Data (concluded)

Oct 1997						
Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
21	100	4	319	14.2	1016.2	0
	700	8	16	16.4	1017.6	0
	1300	2	42	16.5	1017.0	0
	1900	4	184	14.6	1015.2	0
22	100	5	200	16.9	1013.2	0
	700	8	337	11.5	1015.0	5
	1300	7	1	15.0	1015.0	0
	1900	7	4	13.8	1016.5	0
23	100	7	10	12.9	1017.6	0
	700	8	323	10.3	1020.4	0
	1300	3	344	13.6	1020.1	0
	1900	0		8.7	1020.4	0
24	100	3	184	10.3	1020.8	0
	700	3	213	13.3	1022.0	0
	1300	6	150	17.9	1018.8	0
	1900	7	151	18.6	1017.2	0
25	100	10	161	18.8	1012.6	0
	700	4	237	18.2	1011.9	10
	1300	5	234	21.5	1011.8	0
	1900	5	21	19.5	1014.4	0
26	100	8	46	17.7	1017.1	0
	700	8	67	17.6	1017.6	0
	1300	6	1	18.5	1015.4	0
	1900	7	152	19.9	1011.0	0
27	100	7	196	20.9	1005.5	0
	700	9	221	21.1	1004.1	4
	1300	6	218	21.3	1002.9	0
	1900	4	1	17.3	1004.0	0
28	100	11	337	12.1	1010.5	0
	700	11	330	9.0	1016.5	9
	1300	5	352	12.6	1018.1	0
	1900	3	297	11.3	1020.1	0
29	100	2	1	10.6	1020.8	0
	700	3	239	11.8	1022.5	0
	1300	3	207	15.3	1020.5	0
	1900	4	198	13.2	1020.3	0
30	100	3	235	13.0	1020.4	0
	700	2	228	13.1	1021.7	0
	1300	1	119	18.8	1021.1	0
	1900	3	116	16.8	1021.2	0
31	100	4	1	17.6	1020.2	0
	700	4	77	18.3	1019.0	0
	1300	3	93	19.9	1017.2	0
	1900	6	116	19.1	1015.3	0
		Resultant		Mean	Mean	Total
		1	12	19.0	1018.0	72

Wave Data

3

Wave data are collected from three different sets of instruments, as shown in Table 1 and Figure 3. The first is an array of fifteen pressure gauges, collectively referred to as gauge 3111 (gauge 111 being one of them). Directional information is computed from these gauges using an iterative maximum likelihood estimator. The second is a Baylor staff gauge (625) and a pressure gauge (641), both attached to the pier. The third is a Waverider buoy (630). The data are collected, analyzed, and stored on optical disc using a Digital Equipment Corporation VAXstation 4000. Data is sampled at 2 hertz, with five contiguous 34 minute records, for a total collection period of nearly 2 hours and 51 minutes. This report reflects the data collection periods of 0100, 0700, 1300, and 1900 EST. The results are based only on the first 34 minute record. The exception is the 8 Meter Array (3111) which condenses the first four records into one statistical value.

Wave height H_{mo} is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gauge has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 degrees of freedom calculated from a 34-min record. Peak wave period T_p is defined as the period associated with the maximum energy in the spectrum.

Table 4 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 4 are average values computed from this data. Figure 5 is a time history of all H_{mo} and T_p values obtained for all gauges.

Differences in wave periods between wave gauges (Table 4 and Figure 5) may be the result of wave breaking, wave reformation, the presence of multiple wave trains containing nearly equal energy, and statistical variations in spectral estimations.

Table 4
Wave Data

Oct 1997											
Day	Hour	641		625		3111			630		
		Pressure Gauge Hmo,m	Tp,sec	Baylor Gauge Hmo,m	Tp,sec	8 Meter Array Hmo,m	Tp,sec	Dir,TN	Waverider Hmo,m	Tp,sec	
1	0100	0.80	7.4	1.28	7.2	0.38	3.6	6	0.60	3.6	
	0700	0.26	3.7	0.35	3.6	0.44	3.8	26	0.48	3.6	
	1300	0.39	4.9	0.44	4.8	0.53	4.8	30	0.56	5.9	
	1900	0.47	3.9	0.60	3.8	1.01	4.5	0	0.74	3.8	
2	0100	1.20	5.7	1.30	5.5	1.49	5.9	46	1.59	5.3	
	0700	1.06	6.3	1.11	6.1	1.07	5.9	38	1.32	6.3	
	1300	0.78	6.8	0.85	6.6	0.88	6.6	36	1.12	6.7	
	1900	0.56	6.3	0.62	6.3	0.63	6.2	40	0.88	5.6	
3	0100	0.40	6.5	0.56	7.0	0.55	6.6	58	0.69	6.3	
	0700	0.33	5.3	0.46	7.8	0.49	7.6	70	0.59	5.9	
	1300	0.28	17.1	0.47	12.2	0.46	10.8	68	0.51	12.6	
	1900	0.26	16.0	0.41	16.0	0.42	12.0	72	0.52	10.6	
4	0100	0.18	16.0	0.39	11.7	0.38	15.7	76	0.40	11.8	
	0700	0.20	15.1	0.31	10.7	0.35	15.7	78	0.36	10.6	
	1300	0.17	16.0	0.33	15.1	0.34	15.7	78	0.35	10.6	
	1900	0.24	15.1	0.37	2.6	0.33	13.6	60	0.48	14.3	
5	0100	0.18	12.2	0.36	8.3	0.35	13.6	82	0.39	13.4	
	0700	0.23	5.9	0.32	5.3	0.36	6.6	106	0.44	13.4	
	1300	0.17	14.3	0.30	12.9	0.31	13.6	80	0.34	8.4	
	1900	0.17	13.5	0.28	12.9	0.32	13.6	74	0.37	12.6	
6	0100	0.17	11.7	0.31	11.7	0.35	12.0	68	0.36	11.8	
	0700	0.23	11.7	0.40	9.9	0.51	12.0	84	0.49	11.2	
	1300	0.28	11.2	0.53	11.2	0.59	10.8	84	0.55	10.6	
	1900	0.28	10.7	0.52	10.7	0.64	10.8	86	0.66	11.2	
7	0100	0.27	10.7	0.46	10.7	0.51	10.8	68	0.57	10.6	
	0700	0.20	9.9	0.41	9.5	0.46	9.8	68	0.47	10.1	
	1300	0.22	10.3	0.35	10.3	0.44	9.8	84	0.42	10.1	
	1900	0.22	10.3	0.41	10.3	0.45	9.8	72	0.51	9.1	
8	0100	0.29	10.7	0.44	10.3	0.50	9.8	68	0.59	10.1	
	0700	0.43	3.7	0.65	9.5	0.63	9.8	60	0.77	10.1	
	1300	0.43	4.1	0.65	4.2	0.66	4.1	38	0.78	10.1	
	1900	0.38	4.5	0.74	7.4	0.67	7.1	70	0.74	8.4	
9	0100	0.35	8.9	0.61	8.6	0.61	8.2	68	0.76	6.7	
	0700	0.30	9.2	0.64	8.1	0.67	8.2	70	0.73	7.2	
	1300	0.42	9.5	0.76	9.2	0.82	8.9	72	0.83	9.1	
	1900	0.35	10.7	0.73	11.2	0.79	10.8	90	0.88	9.1	
10	0100	0.35	9.9	0.62	9.5	0.71	9.8	72	0.74	10.1	
	0700	0.30	14.3	0.69	8.6	0.73	12.0	90	0.71	9.1	
	1300	0.45	12.2	0.67	12.2	0.75	12.0	60	0.73	11.2	
	1900	0.34	11.2	0.71	11.2	0.70	10.8	84	0.71	10.6	

Table 4
Wave Data (continued)

Oct 1997											
Day	Hour	641		625		3111			630		
		Pressure Hmo,m	Gauge Tp,sec	Baylor Hmo,m	Gauge Tp,sec	8 Meter Hmo,m	Array Tp,sec	Dir,TN	Waverider Hmo,m	Tp,sec	
11	0100	0.35	10.7	0.57	12.2	0.71	12.0	90	0.64	10.6	
	0700	0.58	3.8	0.90	10.7	1.09	4.8	34	0.80	11.8	
	1300	0.91	5.3	1.04	5.4	1.19	5.3	38	1.31	5.3	
	1900	0.89	5.3	1.18	5.6	1.17	5.9	40	1.31	5.9	
12	0100	0.94	6.0	1.12	10.7	1.16	10.8	58	1.29	11.2	
	0700	0.69	5.7	0.95	10.7	0.96	10.8	84	1.06	11.2	
	1300	0.63	12.9	0.93	12.2	1.01	10.8	90	1.08	10.6	
	1900	0.58	10.7	0.90	10.7	0.87	10.8	78	1.00	11.2	
13	0100	0.51	9.9	0.84	10.3	0.87	10.8	60	0.96	10.1	
	0700	0.45	11.2	0.73	10.3	0.73	10.8	84	0.86	11.2	
	1300	0.41	13.5	0.71	9.5	0.74	10.8	64	0.77	9.1	
	1900	0.37	10.3	0.63	9.2	0.63	10.8	86	0.68	11.8	
14	0100	0.31	9.5	0.63	9.5	0.57	10.8	86	0.68	10.1	
	0700	0.32	13.5	0.50	8.9	0.53	10.8	70	0.59	10.6	
	1300	0.25	13.5	0.52	10.7	0.53	10.8	64	0.55	10.1	
	1900	0.30	12.9	0.50	9.9	0.46	12.0	72	0.55	11.2	
15	0100	0.22	12.9	0.50	12.2	0.45	12.0	72	0.54	11.2	
	0700	0.66	4.4	0.90	4.2	0.98	4.6	12	1.12	4.4	
	1300	0.77	5.0	0.90	9.9	1.03	4.8	34	1.23	5.1	
	1900	1.01	5.1	1.16	5.0	1.29	5.0	32	1.38	5.1	
16	0100	0.87	5.5	1.13	10.7	1.17	5.3	28	1.36	5.1	
	0700	0.87	10.7	1.14	10.7	1.20	10.8	78	1.32	10.6	
	1300	1.08	11.7	1.53	6.3	1.65	10.8	86	1.68	11.8	
	1900	1.30	6.5	1.61	6.1	1.78	6.2	60	1.88	7.2	
17	0100	1.09	6.6	1.57	6.3	1.72	10.8	64	1.82	6.3	
	0700	1.25	11.7	1.62	11.7	1.66	10.8	86	1.82	10.6	
	1300	0.98	10.7	1.48	10.7	1.54	10.8	60	1.70	11.2	
	1900	1.11	11.2	1.54	11.2	1.56	10.8	68	1.82	10.6	
18	0100	0.88	10.7	1.23	6.3	1.34	10.8	66	1.42	6.3	
	0700	0.93	5.9	1.12	6.5	1.27	10.8	68	1.42	6.3	
	1300	1.41	7.8	2.06	7.6	2.23	7.6	58	2.37	7.2	
	1900	1.51	7.6	2.03	8.3	2.23	8.2	60	2.31	8.4	
19	0100	1.33	6.5	1.88	11.7	1.90	7.1	60	2.15	6.7	
	0700	1.77	6.8	2.19	6.8	2.50	7.6	52	2.52	7.2	
	1300	1.60	7.8	2.77	8.3	3.30	9.8	64	2.98	8.4	
	1900	1.60	9.2	2.70	9.9	3.10	10.8	68	3.43	10.6	
20	0100	1.47	11.2	2.15	11.2	2.26	10.8	66	2.53	11.2	
	0700	1.37	11.2	1.98	11.2	2.19	12.0	68	2.14	10.1	
	1300	1.38	12.9	1.75	12.9	1.98	13.6	74	2.07	12.6	
	1900	1.26	12.9	1.92	12.9	2.15	13.6	56	2.11	12.6	

Table 4
Wave Data (concluded)

Oct 1997											
Day	Hour	641 Pressure Gauge		625 Baylor Gauge		3111 8 Meter Array			630 Waverider		
		Hmo,m	Tp,sec	Hmo,m	Tp,sec	Hmo,m	Tp,sec	Dir,TN	Hmo,m	Tp,sec	
21	0100	1.28	13.5	1.70	12.9	1.81	13.6	68	1.78	13.4	
	0700	1.24	13.5	1.70	12.2	1.80	13.6	76	2.02	12.6	
	1300	1.26	14.3	1.57	12.9	1.72	13.6	54	1.78	12.6	
	1900	1.10	12.9	1.53	13.5	1.57	13.6	68	1.56	12.6	
22	0100	0.75	12.9	1.14	12.9	1.27	12.0	60	1.37	12.6	
	0700	0.74	12.2	1.12	12.2	1.16	12.0	66	1.42	11.8	
	1300	0.71	12.9	1.06	12.9	1.20	12.0	66	1.22	11.8	
	1900	0.76	5.4	1.02	11.7	1.15	12.0	62	1.25	11.8	
23	0100	1.03	5.6	1.13	11.7	1.22	12.0	90	1.47	11.8	
	0700	0.81	5.7	1.06	10.7	1.07	10.8	62	1.29	5.6	
	1300	0.68	5.7	0.85	5.6	0.84	12.0	94	1.03	5.3	
	1900	0.51	5.3	0.66	11.7	0.68	10.8	94	0.80	10.6	
24	0100	0.35	4.9	0.50	11.2	0.51	10.8	92	0.59	10.6	
	0700	0.19	10.3	0.40	10.3	0.41	10.8	86	0.47	10.1	
	1300	0.26	11.2	0.43	2.8	0.35	10.8	82	0.55	11.2	
	1900	0.21	2.5	0.40	2.5	0.54	4.2	96	0.42	11.2	
25	0100	0.66	5.0	0.86	5.1	1.07	5.6	104	1.13	5.3	
	0700	0.60	7.6	0.99	7.6	0.97	7.6	106	1.30	8.4	
	1300	0.41	7.2	0.62	7.6	0.73	8.2	84	1.01	7.7	
	1900	0.35	7.6	0.64	7.8	0.75	7.6	88	0.76	7.7	
26	0100	0.83	5.1	1.04	4.9	1.06	5.0	26	1.38	5.1	
	0700	0.71	5.5	0.96	4.5	0.98	5.6	44	1.13	4.6	
	1300	0.81	5.5	1.06	5.2	1.11	4.8	34	1.29	5.1	
	1900	0.80	6.5	0.95	6.8	1.03	7.1	104	1.17	7.2	
27	0100	0.65	6.5	0.98	7.0	1.11	7.1	56	1.31	7.2	
	0700	0.52	7.8	0.88	7.8	0.88	7.6	96	1.20	7.7	
	1300	0.41	7.6	0.68	8.3	0.76	8.2	58	0.95	7.2	
	1900	0.39	8.6	0.60	8.9	0.62	8.9	58	0.87	10.1	
28	0100	1.43	6.6	1.40	6.6	1.52	6.2	26	1.96	6.3	
	0700	1.36	6.6	1.41	6.6	1.57	6.6	50	1.84	6.3	
	1300	1.08	6.6	1.08	6.6	1.13	6.6	48	1.47	7.2	
	1900	0.72	6.1	0.74	6.5	0.70	6.6	48	0.95	6.3	
29	0100	0.41	5.6	0.53	6.1	0.54	6.6	46	0.68	5.9	
	0700	0.36	5.2	0.43	9.9	0.45	7.1	58	0.51	5.3	
	1300	0.20	6.1	0.39	7.0	0.41	8.9	68	0.48	7.2	
	1900	0.21	15.1	0.33	7.2	0.37	8.9	94	0.46	10.1	
30	0100	0.14	14.3	0.33	8.3	0.34	13.6	96	0.37	9.1	
	0700	0.19	14.3	0.31	14.3	0.35	13.6	64	0.36	8.4	
	1300	0.15	13.5	0.36	13.5	0.38	13.6	96	0.37	13.4	
	1900	0.23	8.9	0.35	9.2	0.40	8.9	104	0.46	12.6	
31	0100	0.20	8.9	0.41	8.9	0.38	8.9	104	0.46	8.4	
	0700	0.41	4.0	0.62	4.0	0.62	4.1	82	0.71	4.1	
	1300	0.25	4.1	0.60	5.0	0.56	4.8	68	0.70	5.1	
	1900	0.58	6.1	0.88	6.6	0.94	6.2	80	1.16	6.3	
Mean		0.63	9.0	0.89	9.0	0.95	9.4	67	1.05	9.0	
Std dev		0.41	3.5	0.53	2.9	0.59	3.0	21	0.61	2.7	

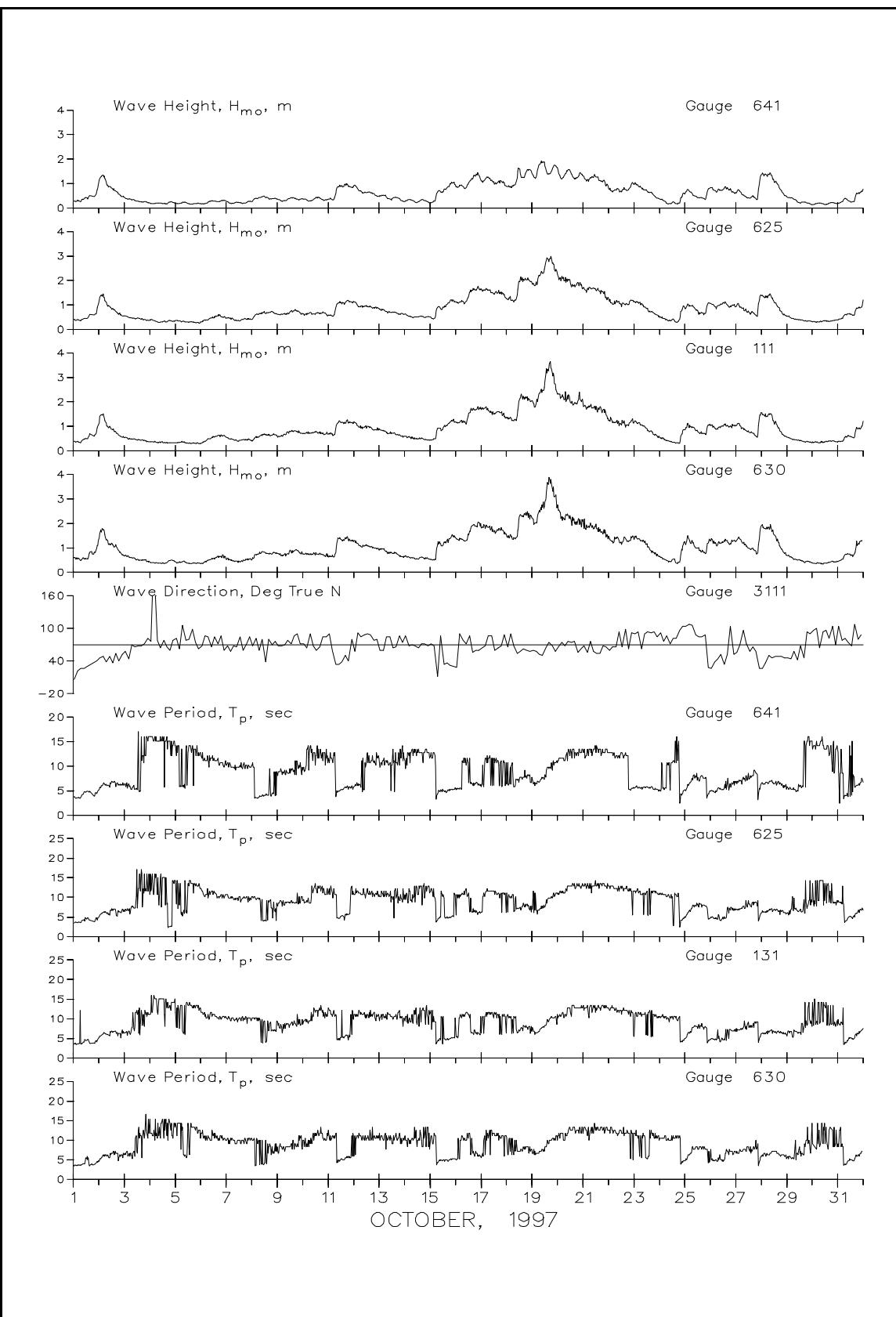


Figure 5. Wave Heights and Periods

Current Data

4

Current data (Table 5) are collected from a Marsh-McBirney electromagnetic biaxial current meter and by visually observing the movement of small drogues on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier, approximately 12 m offshore (Table 6).

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward). All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the cross-shore and longshore data. Current directions indicate the direction that the current is moving towards. Current data are plotted in Figure 2.

Table 5
Current Meter Data - Gauge 3539

OCTOBER 1997																	
	Cross Long				Cross Long				Cross Long								
Day	Time	Shore	Shore	Speed	Dir	Day	Time	Shore	Shore	Speed	Dir	Day	Time	Shore	Shore	Speed	Dir
1	100	0	-3	4	344	1300	-9	16	19	128	22	100	-4	-2	6	40	
	700					1900	-6	24	25	144		700	-2	3	4	114	
1300	-6	21	22	141		12	100	-4	15	16	140		1300	-3	6	7	127
1900							700	-6	14	16	135		1900				
2	100	inoperative				1300	-3	3	5	106	23	100	inoperative				
	700					1900	-5	18	19	141		700					
1300						13	100	-4	5	7	111		1300	-4	8	10	126
1900	-4	14	15	139		700	-3	10	11	141		1900	-4	13	13	140	
3	100	-5	10	12	129	1300	-5	7	10	119	24	100	-3	8	9	132	
	700					1900	-2	5	6	128		700	-2	0	3	72	
1300						14	100	2	2	3	201		1300	1	-8	9	337
1900	1	-2	3	323		700	-3	6	7	128		1900	1	-8	9	334	
4	100	1	-3	4	330	1300		inoperative				25	100	-1	-17	18	347
	700	2	-4	5	320	1900	1	0	1	240		700	2	-7	8	329	
1300	1	-1	2	324		15	100	0	-5	6	338		1300	2	-14	15	332
1900	1	-3	4	327		700	-3	13	14	142		1900	-1	1	2	91	
5	100	0	-2	3	337	1300	-4	16	17	143	26	100	-4	10	11	135	
	700	3	-11	12	327	1900		inoperative					700	-6	16	18	137
1300	1	-3	4	324		16	100	-4	21	21	146		1300	-5	6	8	114
1900	1	-6	7	336		700	-5	22	22	146		1900	-3	3	5	101	
6	100	1	-3	4	328	1300	-5	22	23	145	27	100	0	-4	6	353	
	700	2	-6	7	326	1900	-7	28	30	144		700	1	-6	7	336	
1300						17	100	-7	24	25	142		1300	4	-6	8	308
1900						700	-5	15	16	137		1900					
7	100	inoperative				1300	-5	14	15	138	28	100	inoperative				
	700					1900	-4	7	9	123		700					
1300	-1	1	2	89		18	100	-5	12	14	133		1300	-4	8	10	127
1900	-1	1	2	83		700	-5	19	20	143		1900	-4	3	6	104	
8	100	-1	5	5	141	1300	-10	34	36	141	29	100	-2	-6	7	7	
	700	0	-2	3	356	1900	-7	23	25	140		700	-1	0	2	49	
1300						19	100	-8	37	38	146		1300	0	-11	12	343
1900	-1	16	16	154		700	-10	35	37	143		1900	-1	-11	13	350	
9	100					1300	-16	57	60	144	30	100	-1	-9	11	349	
	700	inoperative				1900	-13	56	58	146		700	-3	-3	6	27	
1300	-1	2	3	115		20	100	-8	34	35	145		1300	-1	-4	6	1
1900	2	5	5	180		700	-5	13	15	135		1900	0	-5	6	347	
10	100	0	2	2	159	1300	-8	27	29	141	31	100	1	-5	6	328	
	700	inoperative				1900	-6	4	8	102		700	-2	-2	4	21	
1300	1	-9	10	333		21	100	-4	-2	6	44		1300	inoperative			
1900	0	0	0			700		inoperative					1900	0	1	1	143
11	100	2	-3	5	321	1300	-8	18	20	134							
	700	-3	10	11	137	1900	-4	9	10	130							

KEY:

+cross-shore = offshore, cm/sec
 -cross-shore = onshore, cm/sec
 +longshore = south, cm/sec
 -longshore = north, cm/sec
 Speed = Resultant speed, cm/sec
 Dir = Resultant direction, degrees true north

Table 6
Visually Observed Current Data

Day	Oct 1997											
	Pier End				Mid-Surf Zone				Beach			
	Cross Shore	Long Shore	Speed	Dir	Cross Shore	Long Shore	Speed	Dir	Location	Speed	Dir	
1	1	18	18	157	3	10	11	143	North	11	S	
2	23	51	56	136	23	152	154	151	North	44	S	
3	-14	32	35	184	6	9	11	127	North	42	S	
4	13	-36	38	359	2	-6	6	359	South	5	N	
5	18	-30	36	11	5	-6	8	20	South	13	N	
6	8	-8	11	24	3	-32	32	346	South	6	S	
7	3	-6	7	9	4	-41	41	346	South	18	N	
8	-5	-12	13	316	-33	-55	65	309	South	11	S	
9	1	-11	11	346	11	-76	77	349	South	20	N	
10	15	-8	17	97	13	10	16	109	South	46	N	
11	11	38	40	143	-7	44	44	169	North	11	S	
12	-12	27	29	184	-29	28	40	206	North	11	S	
13	-5	34	34	169	-12	12	17	206	North	25	S	
14	0	0	0		-1	-8	8	331	South	9	N	
15	-4	76	76	163	-4	76	76	163	North	35	S	
16	14	47	49	143	11	24	27	136	North	25	S	
17	-30	15	34	223	-10	34	35	177	North	25	S	
18	-7	47	47	169	-3	17	18	171	North	27	S	
19	-141	76	160	222	-122	87	150	214	North	88	S	
20	9	47	48	149	26	87	91	143	North	60	S	
21	-12	27	29	184	-69	76	103	202	North	66	S	
22	6	29	30	149	-44	34	56	212	North	25	S	
23	7	47	47	151	-55	61	82	202	North	62	S	
24	2	-7	7	354	21	-47	51	4	South	4	N	
25	10	-23	25	4	17	-87	89	351	South	46	N	
26	-10	-28	29	321	-29	-32	43	298	South	4	N	
27	16	-11	19	34	30	-68	74	4	South	15	N	
28	17	68	70	146	-18	61	64	177	North	48	S	
29	8	-18	20	4	-3	-21	21	331	South	16	S	
30	3	-18	19	349	6	-19	20	357	South	10	N	
31	-3	-8	8	316	5	-19	20	354	South	9	N	

KEY:

- +cross-shore = offshore, cm/sec
- cross-shore = onshore, cm/sec
- +longshore = south, cm/sec
- longshore = north, cm/sec
- Speed = Resultant speed, cm/sec
- Dir = Resultant direction, degrees true north

Visual Observations

5

Visual wave direction measurements (Table 7) of both the primary wave train (i.e. that having the higher wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves) are taken daily at the seaward end of the pier. The pier axis (considered perpendicular to the beach at the FRF) is oriented 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and depth of visibility are also taken daily at the seaward end of the pier. A Bucket Thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The temperature is then read, and a hydrometer is used to determine the density. A Secchi disc is used to determine the depth of visibility.

Table 7
Visual Observations

Oct 1997								
Day	Time	Primary	Secondary	Wave Approach Angle at Pier End (degrees from True N)		Water Characteristics at Pier End		
				Surf Zone	Width, m	Temp., C	Density g/cc	Secchi Vis., m
1	0731	10			12	21.7	1.0230	2.4
2	0715	10			26	21.4	1.0230	0.9
3	0722	10			10	20.6	1.0220	2.4
4	0709	120			12	20.8	1.0216	2.4
5	0758	115			19	21.4	1.0230	1.8
6	0733	125			14	21.7	1.0230	1.5
7	0726	110			14	21.9	1.0232	2.1
8	0731	110	40		24	22.5	1.0228	2.4
9	0732	110	25		12	22.2	1.0216	2.1
10	0630	70			30	21.7	1.0232	1.8
11	1030	45			79	21.7	1.0234	0.6
12	0848	30			29	21.7	1.0232	2.7
13	0758	25			18	21.7	1.0220	2.7
14	0715	120			16	21.7	1.0220	3.7
15	0728	15			16	21.7	1.0228	1.8
16	0723	20	60		29	20.8	1.0230	1.8
17	0739	30	90		47	20.0	1.0230	1.5
18	0724	25	80		41	20.0	1.0216	1.5
19	0721	10			98	20.0	1.0210	0.3
20	0745	35			213	18.6	1.0220	0.9
21	0754	20			191	18.3	1.0226	0.3
22	0908	35	80		71	19.4	1.0232	0.3
23	0730	10			75	18.3	1.0236	0.6
24	0725	125			21	17.2	1.0230	0.9
25	1026	115			51	18.3	1.0232	0.9
26	1057	105			71	18.1	1.0236	0.6
27	1033	95	120		75	18.9	1.0236	0.9
28	0801	20			115	17.8	1.0240	0.9
29	0957	100			26	17.8	1.0024	1.2
30	0720	75			37	16.7	1.0242	1.2
31	0709	90	65		37	17.5	1.0238	0.9

Water Levels

6

Since 1978, the National Oceanic and Atmospheric Administration (NOAA)/National Ocean Service (NOS) has operated a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A NOS acoustic tide gauge (Next Generation Water Level Measurement System, NGWLMS) is used to collect water level data every 6 minutes throughout the month.

The variation in water level during the month is shown in Figure 6 along with a list of means and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water level.

Table 8 contains the range, high, low, and mean water level for each 12.42-hr tidal cycle.

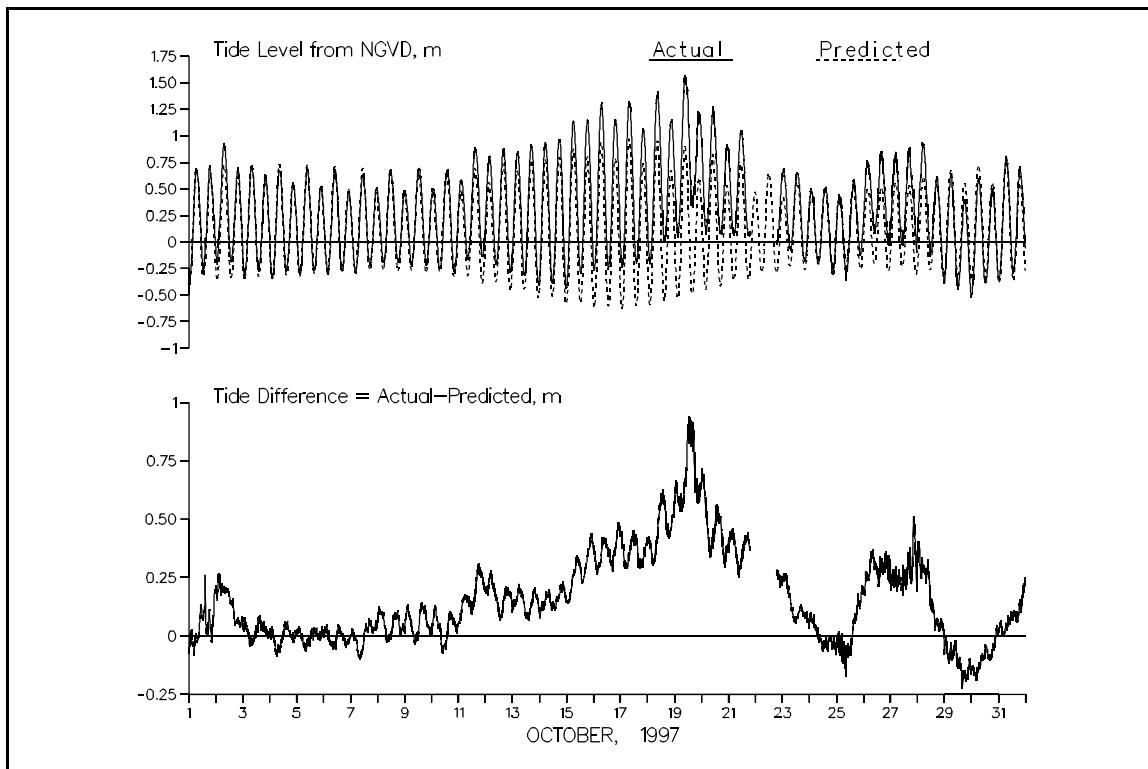


Figure 6. Water Level Variation

Table 8
Water Levels, m NGVD

OCT 1997 Tide Levels																
Day	High			Low			Mean	Range	High			Low			Mean	Range
	Time	m	Day	Time	m	Day			Time	m	Day	Time	m	Day		
1	0630	0.69	1	0018	-0.42		0.21	1.11	16	1924	1.16	16	1254	-0.26	0.47	1.41
1	1830	0.72	1	1248	-0.26		0.23	0.98	17	0724	1.33	17	0142	-0.24	0.55	1.57
2	0724	0.94	2	0118	-0.21		0.38	1.15	17	2018	1.07	17	1418	-0.20	0.43	1.27
2	1936	0.70	2	1348	-0.20		0.24	0.89	18	0842	1.41	18	0212	-0.21	0.60	1.63
3	0800	0.72	3	0142	-0.34		0.20	1.06	18	2118	1.16	18	1454	0.00	0.58	1.16
3	2024	0.63	3	1412	-0.28		0.17	0.91	19	0912	1.57	19	0300	0.04	0.84	1.53
4	0848	0.68	4	0200	-0.34		0.17	1.01	19	2118	1.23	19	1630	0.33	0.78	0.90
4	2024	0.57	4	1430	-0.28		0.14	0.84	20	1024	1.28	20	0406	0.07	0.66	1.21
5	0900	0.70	5	0248	-0.31		0.18	1.01	20	2242	0.92	20	1736	0.07	0.48	0.85
5	2136	0.52	5	1554	-0.27		0.13	0.80	21	1124	1.06	21	0518	0.05	0.54	1.00
6	0942	0.68	6	0342	-0.31		0.19	0.99	21	2330		21	1748	No data this cycle		
6	2236	0.48	6	1624	-0.27		0.10	0.75	22	1148		22	536	No data this cycle		
7	1048	0.64	7	0436	-0.29		0.17	0.93	23	24		22	1842	No data this cycle		
7	2312	0.51	7	1654	-0.22		0.15	0.74	23	1254	0.65	23	0712	-0.08	0.29	0.73
8	1124	0.68	8	0500	-0.19		0.23	0.87	24	0118	0.50	23	2006	-0.19	0.16	0.69
9	0024	0.49	8	1824	-0.19		0.15	0.68	24	1430	0.52	24	0812	-0.21	0.15	0.73
9	1254	0.69	9	0618	-0.23		0.24	0.93	25	0230	0.45	24	2048	-0.31	0.07	0.76
10	0042	0.50	9	1900	-0.22		0.15	0.72	25	1530	0.59	25	0836	-0.36	0.16	0.95
10	1406	0.69	10	0724	-0.25		0.21	0.94	26	0342	0.76	25	2106	-0.13	0.34	0.89
11	0224	0.58	10	2012	-0.28		0.17	0.86	26	1606	0.85	26	0948	0.08	0.45	0.77
11	1448	0.89	11	0754	-0.17		0.37	1.06	27	0454	0.85	26	2236	-0.04	0.40	0.89
12	0336	0.81	11	2136	-0.15		0.33	0.96	27	1718	0.89	27	1118	-0.04	0.42	0.93
12	1554	0.88	12	0912	-0.22		0.32	1.10	28	0442	0.93	27	2318	-0.10	0.47	1.03
13	0442	0.85	12	2148	-0.29		0.28	1.14	28	1724	0.62	28	1136	-0.14	0.24	0.76
13	1642	0.92	13	1106	-0.32		0.30	1.23	29	0548	0.65	29	0006	-0.39	0.12	1.05
14	0518	0.94	13	2318	-0.41		0.28	1.35	29	1812	0.40	29	1206	-0.45	-0.02	0.85
14	1742	0.97	14	1118	-0.39		0.30	1.36	30	0624	0.60	29	2348	-0.52	0.04	1.13
15	0606	1.14	14	2348	-0.44		0.37	1.58	30	1900	0.51	30	1230	-0.39	0.05	0.90
15	1830	1.15	15	1218	-0.29		0.43	1.44	31	0706	0.81	31	0030	-0.37	0.22	1.18
16	0718	1.31	16	0042	-0.27		0.52	1.59	31	1900	0.71	31	1324	-0.29	0.21	1.01

Bathymetry

7

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using a Trimble 4000 SSE GPS for positioning, in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 7 shows the last survey in September and the survey(s) in October on profile line 188, located 517 m south of the pier.

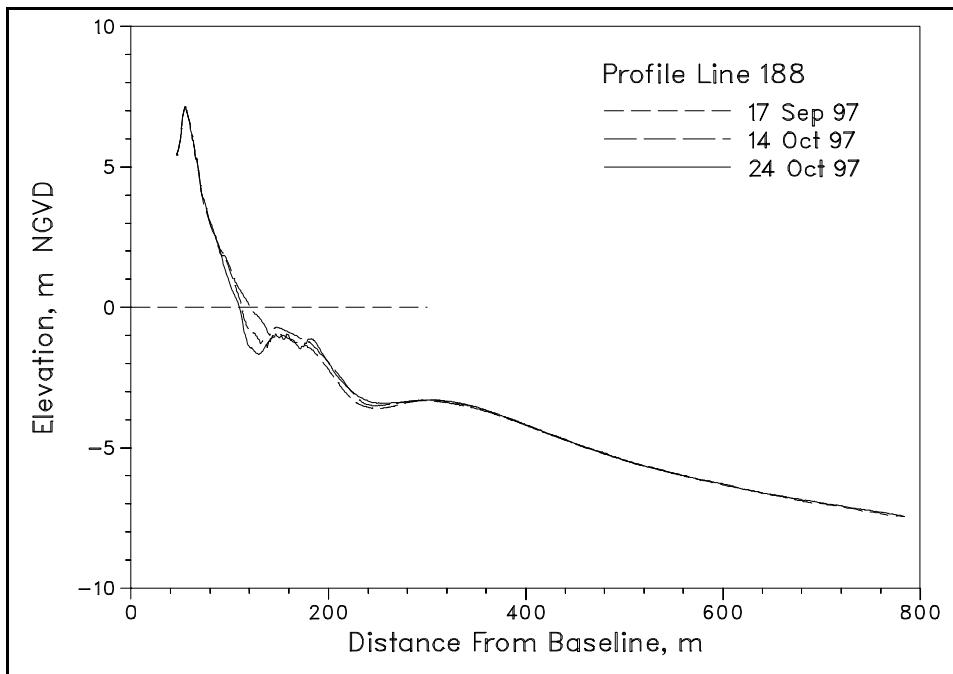


Figure 7. Monthly CRAB Profiles on Profile Line 188.

The profile envelope (Figure 8) reflects the maximum changes that occurred on the profile during 1997. Cross-hatched areas indicate changes to the annual envelope which occurred in October.

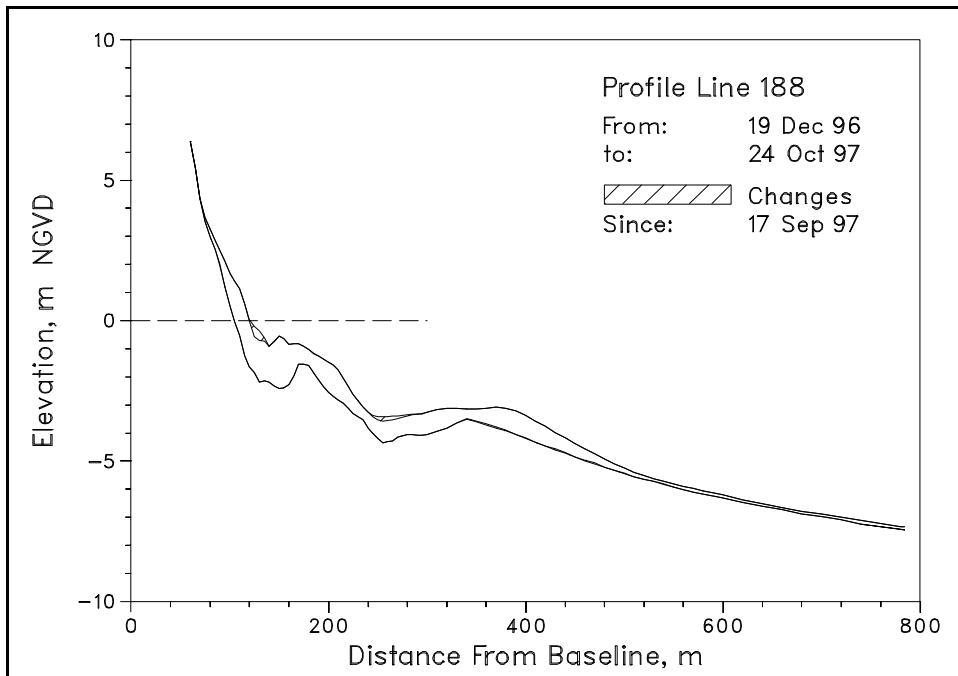
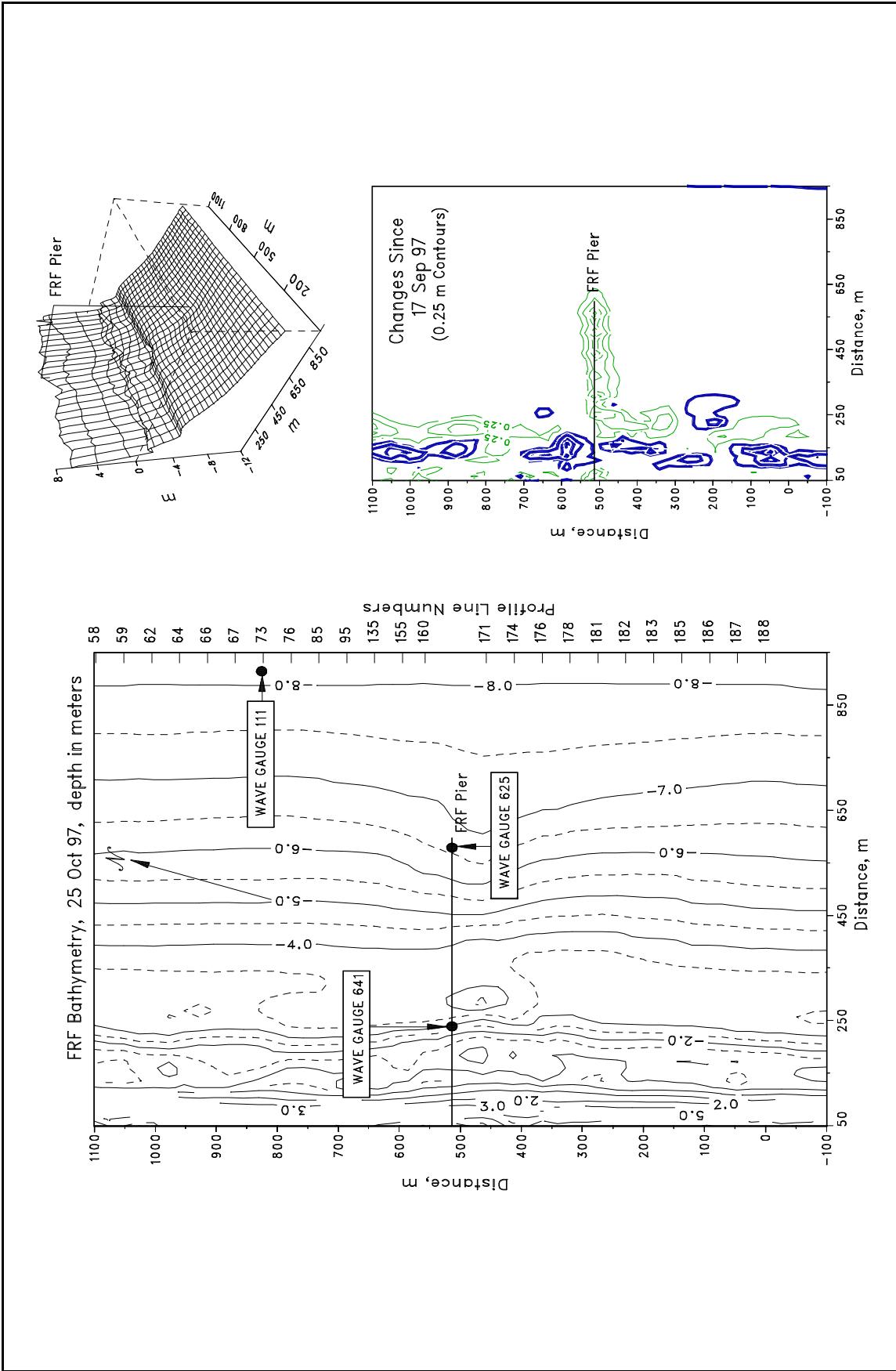


Figure 8. Profile Envelope - Profile Line 188.

B. Bathymetry. Figure 9 includes a two- and three-dimensional contour map and a change plot derived from the bathymetric survey on 25 October. Wide contour lines on the change diagram represent eroded areas; thin lines indicate deposition.



Special Events

8

A. Storm Data Collection. The following list identifies times when the wave height H_{mo} at the seaward end of the pier exceeded 2 m.

<u>Start</u>	<u>End</u>
18 Oct (1216)	20 Oct (1108)

B. Storm Synopsis.

By the morning of 19 October a stationary front had developed into a low pressure system about 100km offshore of Cape Hatteras. Maximum onshore winds (NE) reached 18 m/s at 1408 EST on 19 October. The maximum H_{mo} , at gauge 630, reached 3.87 m ($T_p=9.1$ s) at 1600 EST on 19 October. Atmospheric pressure dipped slightly to 1003 mb at 1142 EST on 19 October. There was 28 mm of precipitation.